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Flood plain
information

STATE DOCUMENTS

PLAIN INFORMATION

ALKALI CREEK

VOLUME II

BILLINGS METROPOLITAN REGION MONTANA

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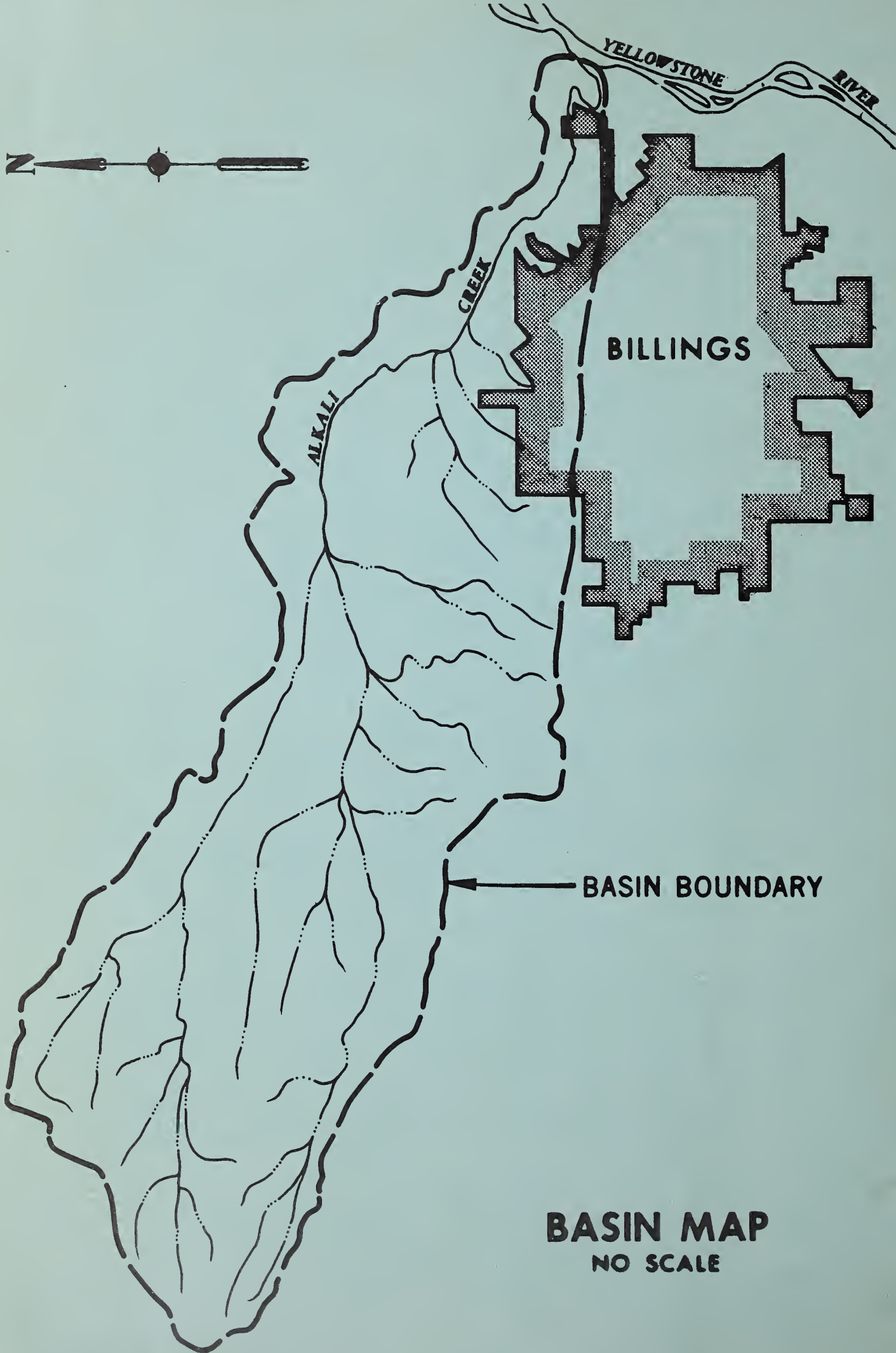


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OMAHA, NEBRASKA
OCTOBER 1969



BASIN MAP
NO SCALE



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INTRODUCTION

This report defines the flood characteristics on Alkali Creek in the vicinity of Billings, Montana. See plate I. It is the second of two volumes and completes the flood plain studies requested by the City of Billings through the Montana Water Resources Board. Volume I contains flood plain information for a .15 mile reach of the Yellowstone River in the vicinity of Billings. The purpose of these reports is to assist local officials and others in identifying the flood hazard areas.

The basin and stream characteristics, flood histories and probable effects of major flooding on Alkali Creek are described in this report. Two potential floods, Intermediate Regional and Standard Project, are used to represent two degrees of major flooding that may occur in the future. These two floods are defined in the Glossary - pages 13 and 14 - and should be given appropriate consideration in planning for developments in the flood plain.

The flood hazard areas defined by the two potential floods are shown on the plates at the end of this report. Flooded area maps show the approximate areas that would be inundated. Profiles show the depths of water relative to the streambed and banks, and flood elevations across the width of the valley. The cross sections indicate ground level across the valley and the relative flood depths.

This report is not concerned with any plans for flood control on Alkali Creek. Flood hazard information is provided for the guidance of local officials and individuals in planning the use and regulation of the flood plain and as public information. Awareness and use of these data will help avoid the dangers and damages from future floods.

Technical assistance to Federal, State, and local agencies for interpretation and use of the information contained in

this report will, upon request, be provided by the Omaha District, Corps of Engineers. Zoning or other regulation of flood plain use is a local responsibility, but the Corps of Engineers will provide guidelines if requested. A pamphlet, "Guidelines for Reducing Flood Damages," and a booklet "Introduction to Flood Proofing" can be supplied. Other publications and services are available depending on supply and funds.

The information given in this report does not imply any Federal interest or authority to zone or regulate use of the flood plains, nor should it be construed as obligating the Government to investigate, construct or maintain any facility discussed herein. The flood profiles and flooded area data presented are based on existing drainage basin, stream and valley conditions at the time the report was prepared, and are reasonable, rather than precise, indications of probable occurrences. Urbanization of the drainage basin may increase runoff and flooding. The use to which flood plain information will be put is the responsibility of local authorities.

SUMMARY OF THE FLOOD SITUATION

Alkali Creek flows easterly past the northern edge of Billings. The stream is small and deeply etched in the plateau northwest of Billings. The flood plain is narrow and mostly undeveloped.

* * *

THE CAUSE OF FLOODS on Alkali Creek is intense rainfall during thunderstorms. Snowmelt accelerated by Chinook winds have also produced flooding in the basin.

* * *

GREAT FLOODS have occurred on Alkali Creek. The largest flood of record occurred in 1937 with an estimated discharge of 13,000 cubic feet per second. The second largest flood occurred in 1923 and was reported to be of nearly the same magnitude of the 1937 flood.

* * *

FLOOD DAMAGES from past floods on Alkali Creek have been restricted to bridges and the Billings Bench Water Association (hereafter B.B.W.A.) Siphon within the study reach. The Midland Empire Fairgrounds downstream of the study reach has been damaged heavily by floodwaters.

* * *

DURATION OF FLOODING on Alkali Creek is short only lasting a few hours.

* * *

HAZARDOUS CONDITIONS would occur during large floods as a result of rapidly rising streams, high velocities, and deep flows. Velocities greater than 3 feet per second combined with depths of 2 feet or greater are generally considered hazardous. All overbank flows on Alkali Creek may be dangerous and should be avoided or approached with caution.

* * *

FLOOD CONTROL AND DEFENSE against flood hazards have not been provided for Alkali Creek. Plans for flood control have been made in the past and new plans continue to be discussed, but none have materialized. The Army Corps of Engineers has developed a diversion plan for lower Alkali Creek that would protect the Midland Empire Fairgrounds. This plan was authorized for construction but not built because of the lack of required local sponsorship and financial participation.

GENERAL CONDITIONS

This section describes the general characteristics of Alkali Creek with emphasis on the reach covered by this report.

Stream and Valley Characteristics

Alkali Creek is a small left bank tributary of the Yellowstone River at Billings. From its source, on the plateau northwest of Billings, the stream flows easterly passing north of the Billings Municipal Airport and through the Midland Empire Fairgrounds. The Alkali Creek drainage basin contains 41 square miles and is about 15 miles long and 3.5 miles wide, but narrowing in the lower basin.

The portion of Alkali Creek studied in this report extends from the Northern Pacific Railroad bridge, west of the Fairgrounds, to a point 3.1 miles upstream. Sandstone rimrocks border the valley which lies about 100 feet below the plateau. A vee shaped channel meanders across the valley floor. The channel averages 9 feet deep and is about 100 feet wide at the top. Its bed has an average slope of 30 feet per mile within the study reach. A narrow flood plain extends out from one or both banks of the creek. The total flood plain width varies from 200 to 500 feet wide. The photographs on pages 6 and 7 show Alkali Creek at several of the bridge crossings.

Development on the Flood Plain

The Alkali Creek flood plain is mostly undeveloped pastureland, but some of it is platted for house lots. A few homes are located on the valley floor occupying positions at the edge of or above the flood plain. Alkali Creek Road provides access to the valley for additional development. The flood hazard should be taken into account as Billings plans expansion into the Alkali

Creek Basin.

Bridges Across the Stream

Alkali Creek is crossed by the B.B.W.A. Siphon, U.S. Highways 87 and 312, Bench Boulevard, and the Northern Pacific Railroad. Table I provides pertinent information on the structures and their relationships to the Intermediate Regional Flood.

Obstructions to Flood Flow

The waterway opening through the U.S. Highway 87 and 312 crossing is inadequate for the Intermediate Regional Flood. The roadway would be overtopped by the floodwaters. The high road embankment acts like a dam and raises the upstream water surface about 25 feet.

TABLE I
BRIDGES ACROSS ALKALI CREEK

<u>Miles Above Mouth</u>	<u>Identification</u>	<u>Stream Bed Elev. feet</u>	<u>Intermediate</u>		<u>Standard Project Flood Crest feet</u>	<u>Underclearance</u>		<u>1/ Relation to Inter. Reg. Flood Below feet</u>
			<u>Deck Elev. feet</u>	<u>Regional Flood Crest feet</u>		<u>Elev. feet</u>	<u>Above feet</u>	
2.50	B.B.W.A. Siphon	3152.3		3164.2	3167.6	3171.2	7.0	
1.50	Hwy 87 & 312 15' Dia. Culvert	3121.5	3155.5	3155.9	3157.7	3136.5		19.4
0.94	Abandoned Bridge (Bench Blvd.)	3101.0	3114.5	3116.9	3121.1	3113.0		3.9
0.89	Northern Pacific RR	3100.1	3120.0	3116.6	3120.8	3119.0	2.4	



View looking upstream at Billings Bench
Water Association Siphon across Alkali Creek.



View looking upstream at Abandoned
Bridge (Bench Blvd.) across Alkali Creek.



View looking upstream at the Northern
Pacific RR Bridge across Alkali Creek.

PAST FLOODS

This section presents the flood history of Alkali Creek.

Flood Records

Stream gaging records are not available for comparing floods on Alkali Creek. However, news accounts of certain floods indicate the nature of flooding on Alkali Creek.

Major rainstorm floods occurred in 1923 and 1937. A significant snowmelt flood occurred in 1887. Over a long time minor floods have been experienced about once every five years.

Duration and Rate of Rise

Flooding usually begins late during or immediately after a severe rainstorm. The floods usually last about 5 hours with the peak occurring in the middle of the period.

Flood Descriptions

The largest floods on Alkali Creek were produced by rain and hail during a cloud burst type thunderstorm. Snowmelt type floods are possible as indicated by local accounts of the March 1887 snowmelt flood. Descriptions of the two largest floods are provided to illustrate the flood potential.

11 June 1937

The largest flood in the lower Alkali Creek basin occurred in June 1937 when a severe hail and rainstorm swept across a small area west and north of Billings. The storm traveled in a northeasterly direction on a path about 15 miles wide. The storm began about 6:00 p.m. and lasted until about 9:30 p.m. For this period 2.78 inches of precipitation was recorded at the Billings Airport of which 1.5 inches fell in 1 hour. At the storm center

approximately 5 miles northwest of the Airport, 7 inches of precipitation was reported most of which fell in a 30 minute period. • Flooding began in the Fairgrounds area about 8:00 p.m. and reached a peak discharge of 13,000 c.f.s. about 11:00 p.m. Principal damage within the study reach was the loss of the Alkali Siphon owned by the Billings Bench Water Association. Direct costs of replacement amounted to \$49,800 while indirect costs resulting from the loss of irrigation water for 6 weeks was estimated at \$216,900.

July 1923

The second largest flood on Alkali Creek occurred in mid July 1923. It was caused by a cloud burst in the upper portion of the basin where it reportedly equaled the 1937 flood. There was very little rainfall in the lower basin and lacking supplemental runoff the 1923 flood diminished as it moved downstream. Damages in the lower basin were not nearly as great as during the 1937 event.



Aftermath of 1937 flood along U.S.
Highway 87 on west boundary of Fairground.



Repair of U.S. Highway 87 Bridge after 1937 flood.
Note debris in R.R. trestle.

POTENTIAL FLOODS

This section discusses the Intermediate Regional and the Standard Project Floods and their effects on the basin. The Intermediate Regional Flood represents a flood with an average frequency of occurrence of about once in one hundred years and is increasingly being accepted by the public as the minimum standard for flood plain regulations, flood proofing and flood control. The Standard Project Flood is of greater magnitude and represents a reasonable upper limit of expected flooding. However, larger floods are possible. It is emphasized that floods which are smaller than the Intermediate Regional Flood are much more likely to occur. Although these lesser floods inundate smaller areas, they should not be disregarded.

Intermediate Regional Flood

Records of rainfall and discharge measurements are not available for past Alkali Creek floods. Therefore, the flood frequency - discharge relationships were developed from a regional correlation of data for similar streams where records are available. The Intermediate Regional Flood was determined to have a discharge of 6,500 cubic feet per second in the study reach.

Standard Project Flood

The Standard Project Flood is presented in this report as a practical upper limit of flooding. Storms that would produce this flood are uncommon and it is difficult to assign frequencies of occurrence with any reasonable degree of accuracy. However, floods of this size are not impossible. For example, the floods in June 1964 on the Sun and Marias Rivers, Montana were of Standard Project Flood magnitude at several locations. These floods were caused by a combination of heavy rainfall on rapidly melting snow.

The Standard Project Flood for Alkali Creek is 15,000 cubic feet per second in the study reach.

Greater Floods

Floods even larger than the Standard Project Flood are possible, but the combination of factors necessary to produce such large floods is extremely severe and rare. Floods greater than the Standard Project Flood are not further discussed in this report although they should not be overlooked where it is necessary to eliminate all risk of flooding.

Hazards of Great Floods

The effects of the Intermediate Regional and Standard Project Floods on Alkali Creek were analyzed to determine the flood potential. The analysis was made using 32 bridge and valley cross sections surveyed in 1969. The water surface profiles were determined by backwater computations using the Standard Step Method. The bridge head losses were computed by using the data in "Hydraulics of Bridge Waterways" published by the U.S. Department of Commerce.

The extent of flooding is shown on the "Flooded Area," plate 1. Flood outlines were determined, from the cross section survey data and available U.S. Geological Service topographic map, to show general areas subject to flooding. For any specific situation, where accuracy is needed, it will be necessary to take the appropriate flood elevation from the profile and locate by survey its corresponding ground elevation on the flood plain.

The water surface profiles for the Intermediate Regional and Standard Project Floods are shown on the "Profile and Cross Section" plate 2. The profiles show the depths of flooding in the channel and the elevations of the water surfaces over the adjacent flood plain. The cross sections portray the channel and valley characteristics and show the depths of overbank flooding.

Reference points have been provided to pinpoint flood elevation at intervals along the stream. The reference points coincide with the location of the cross sections which were used to make the study. The location of the reference points are shown on plate 1 and plate 2. A tabulation of the reference points is shown in table 2. The tabulation shows the elevations of the stream-bed and the Standard Project and Intermediate Regional Floods. It also gives the bearing of a reference line which, when drawn through the reference point across the flood plain, shows where the flood elevations are applicable.

TABLE 2
FLOOD PLAIN REFERENCE DATA
ALKALI CREEK

<u>Cross Section Symbol</u>	<u>Reference Point Number</u>	<u>Stream Bed Elevation Ft. M.S.L.</u>	<u>Intermediate Regional Flood Elevation Ft. M.S.L.</u>	<u>Standard Project Flood Elevation Ft. M.S.L.</u>	<u>Bearing</u>
32	1	3195.2	3207.8	3212.1	N 46° E
31	2	3189.8	3202.8	3207.2	N 58° E
30	3	3188.3	3199.2	3203.3	N 81° E
29	4	3184.2	3190.6	3193.8	N 89° E
28	5	3174.7	3185.8	3189.6	N 48° E
27	6	3172.2	3184.2	3188.3	N 26° E
26	7	3170.8	3181.6	3184.8	N 13° E
25	8	3167.6	3178.8	3182.0	N 38° E
24	9	3162.5	3173.5	3175.8	N 8° E
23	10	3152.6	3166.6	3170.5	N 7° E
21	11	3151.0	3163.5	3166.5	N 10° E
20	12	3148.5	3161.0	3163.6	N 16° W
19	13	3144.3	3157.2	3161.5	N 8° W
18	14	3139.9	3155.9	3157.7	N 10° W
17	15	3135.4	3155.9	3157.7	N 17° W
16	16	3127.4	3155.9	3157.7	N 22° E
15	17	3125.9	3155.9	3157.7	N 26° W
14	18	3122.7	3155.9	3157.7	N 16° E
12	19	3119.3	3129.9	3133.4	N 36° E
11	20	3119.0	3126.6	3130.1	N 90° E
10	21	3110.1	3123.3	3128.2	N 22° W
9	22	3107.8	3120.2	3124.0	N 47° W
8	23	3103.2	3117.6	3121.8	N 61° W
6	24	3101.0	3116.6	3120.8	N 70° E

Note: Bridge sections and those downstream from the N. P. R.R. bridge not listed.

GLOSSARY OF TERMS

Flood

An overflow on lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river or stream or an ocean, lake or other body of standing water.

Normally a "flood" is considered as any temporary rise in stream flow or stage, but not the ponding of surface water, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of groundwater coincident with increased stream flow, and other problems.

Flood Crest

The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Plain

The relatively flat area or low lands adjoining the channel of a river, stream or water course or ocean, lake, or other body of standing water, which has been or may be covered by flood-water.

Flood Profile

A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It

is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage

The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

Head Loss

The effect of obstructions, such as narrow bridge openings or buildings that limit the area through which water must flow, raising the surface of the water upstream from the obstruction.

Intermediate Regional Flood

A flood having a one percent probability or an average frequency of occurrence in the order of once in 100 years although the flood may occur in any year. It is based on statistical analyses of stream flow records available for the watershed and analyses of rainfall and runoff characteristics in the "general region of the watershed."

Left Bank

The bank on the left side of a river, stream or water course, looking downstream.

Low Steel (or Underclearance)

See "Underclearance."

Right Bank

The bank on the right side of a river, stream or water course, looking downstream.

Standard Project Flood

The flood that may be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations. Peak discharges for these floods are generally about 40 percent to 60 percent of the Probable Maximum Floods for the same basins. Such floods, as used by the Corps of Engineers, are intended as practicable expressions of the degree of protection that should be sought in the design of flood control works, the failure of which might be disastrous.

Underclearance

The under side of a bridge or other structure over or across a river, stream or water course that limits the opening through which water flows. This is referred to as "low steel" in some regions. For culverts or arched structures - through which water flows - the crown or top of arch is called "underclearance" in this publication.

AUTHORITY, ACKNOWLEDGEMENTS, AND INTERPRETATION OF DATA

This report has been prepared in accordance with the authority granted by Section 206 of the Flood Control Act of 1960 (Public Law 86-649) as amended.

* * *

Assistance and cooperation of the City of Billings and the U.S. Geological Survey in supplying useful data are appreciated.

* * *

This report presents the local flood situation along the Alkali Creek at Billings, Montana. The Omaha District of the Corps of Engineers will provide interpretation of the data presented herein and limited technical assistance to local officials who will use the data.



LEGEND:

INTERMEDIATE REGIONAL FLOOD

STANDARD PROJECT FLOOD

3.0

Stream Miles Above Mouth

3

Channel and Valley Cross Section

2

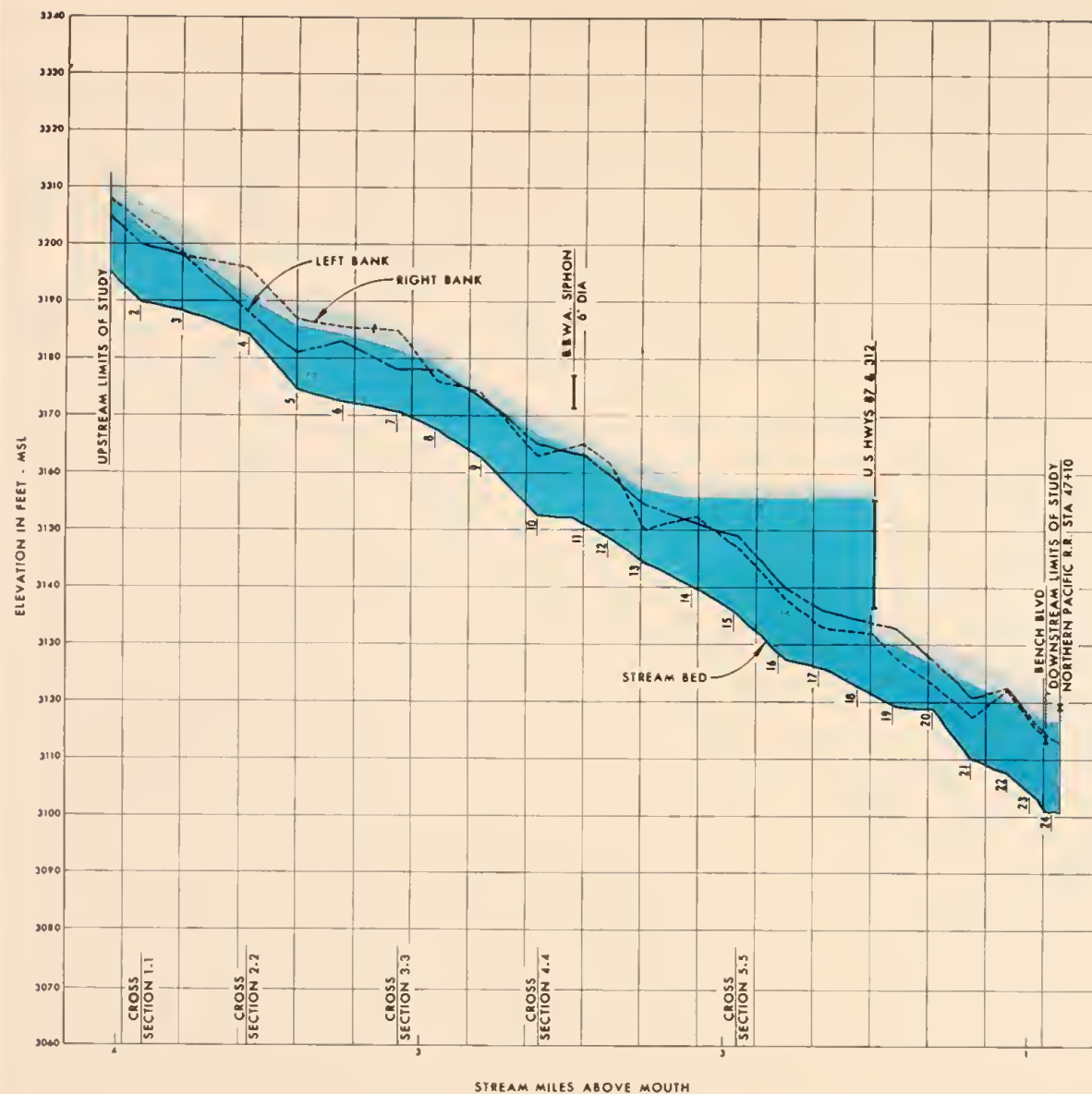
Reference Point - Also locations of surveyed cross sections

- NOTES:**
- 1. For Illustrated Cross Sections see Plate 2.
 - 2. See Plate 2 for profile.
 - 3. See Table 2 for flood elevations of the reference points.

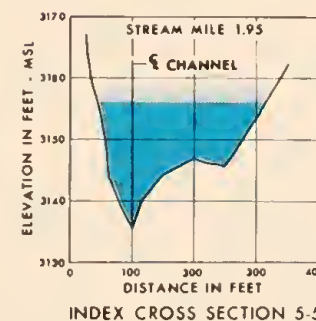
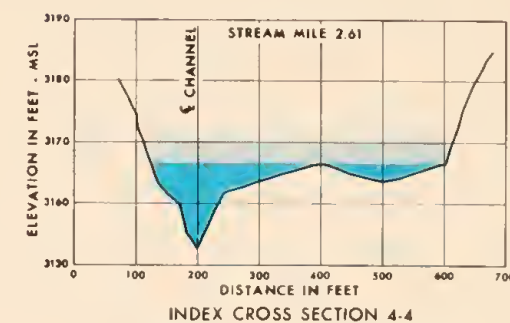
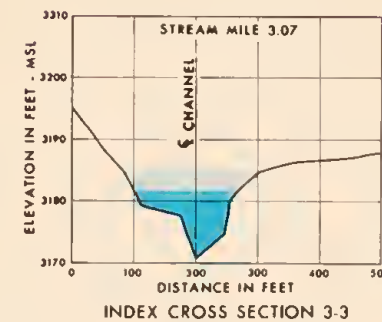
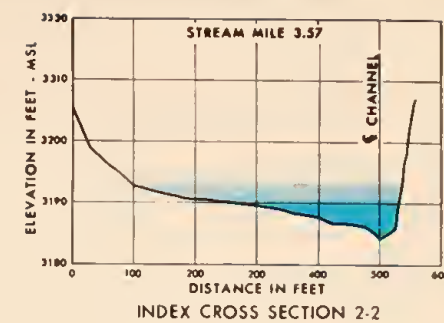
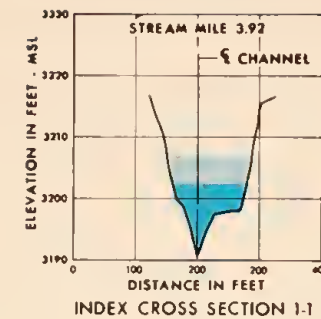
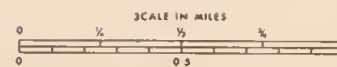
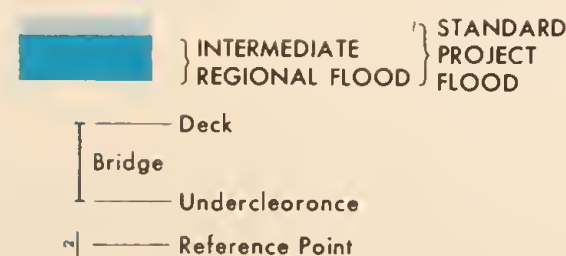


**YELLOWSTONE RIVER BASIN
BILLINGS, MONTANA
ALKALI CREEK
FLOODED AREAS**

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1969



LEGEND:



THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

NOTES:

1. For location of cross sections, see Plate 1.
2. See Table 2 for flood elevations at the reference points.

YELLOWSTONE RIVER BASIN BILLINGS, MONTANA ALKALI CREEK PROFILE AND CROSS SECTIONS

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1969

